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Windlasses and anchor capstans [TED 19: Marine Engineering
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सामान्य अपेक्षाएं
(दूसरा पुनरीक्षण)

Indian Standard
SHIPBUILDING — TESTING OF WINDLASSES —
GENERAL REQUIREMENTS
(*Second Revision*)

ICS 47.040

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BUREAU OF INDIAN STANDARDS
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FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards after the draft finalized by the Marine Engineering Sectional Committee had been approved by the Transport Engineering Division Council.

This standard was first published in 1975 and revised in 1981 to align it with international standard. Subsequent to this revision, a separate Indian Standard has been formulated covering the general requirements for ship's deck machinery. Consequently, in the second revision of this standard, all the requirements pertaining to control methods and movements and constructional details have been deleted. Besides this, performance requirements have also been updated to bring them in line with international practice.

In the preparation of this second revision, assistance has been derived from:

- i) BSMA 35 Specification for ship's deck machinery — Windlasses issued by the British Standards Institution (BSI)
- ii) ISO 4568 - 1986 Shipbuilding — sea-going vessels — Windlasses and anchor capstans issued by the International Organization for Standardization (ISO).

Indian Standard

SHIPBUILDING — TESTING OF WINDLASSES — GENERAL REQUIREMENTS

(*Second Revision*)

1 SCOPE

This Indian Standard specifies the general requirements, performance and testing of windlasses fitted on board ocean-going ships using anchor chains of nominal size 26 to 120 mm.

2 REFERENCES

The following standards contain provisions which through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

<i>IS No.</i>	<i>Title</i>
4484: 1994	Shipbuilding — Electrically welded stud link anchor chains and connecting shackles and swivels (<i>second revision</i>)
6675: 1972	Cables lifters for windlasses
8650	Shipbuilding — Deck machinery — Glossary of terms and graphical symbols
(Part 1): 1989	Deck machinery (<i>first revision</i>)
(Part 2): 1989	Anchoring and mooring (<i>first revision</i>)
(Part 3): 1989	Cargo handling (<i>first revision</i>)
(Part 4): 1989	Towing (<i>first revision</i>)
(Part 5): 1989	Ancillary deck equipment (<i>first revision</i>)
12719: 1989	Shipbuilding — Deck machinery — General requirements

3 TERMINOLOGY

For the purpose of this standard, the following definitions, in addition to those given in IS 8650 (Parts 1 to 5) shall apply.

3.1 Working Load of the Windlass, F_w

The working load of the windlass measured at the cable lifter exit when the windlass is operating at its minimum design speed. It is derived from cable diameter and the cable grade.

3.2 Nominal Size of the Windlass

The nominal size is derived from the working load of the windlass at its design speed. It is a number proportional to the working load, which is expressed in tonnes and is the nearest lower preferred whole number to the working load.

3.3 Overload Pull

The necessary temporary overload capacity of the windlass; and it is generally between 1.5 times the duty pull of the windlass.

3.4 Holding Load

The maximum static load on the chain cable which the cable lifter brake shall withstand. It is 0.45 times for Grade 1, 0.63 times for Grade 2 and 0.90 times the breaking load of the special steel cable as per IS 4484, in the case of the windlass with the cable stopper.

3.5 Nominal Speed

The average speed of recovery of two lengths of chain cable when three lengths are submerged and freely suspended at the commencement of liftings.

3.6 Torque Limiter

This is a stress limiting bar placed between the motor and the reduction gear, so adjusted as to make it possible to transmit the starting torque, to absorb the force of inertia of the motor in the case of sudden stoppage of chain and to absorb any force greater than the normal force by 25 percent. Slipping clutch may be used as torque limiter for electric windlasses. For hydraulic windlasses, the relief valve shall act as limiter.

3.7 Symmetrical Double Cable Lifter Windlass : Type 1

Fully powered windlass with the two symmetrical cable

lifters (see Fig. 1A).

3.8 Single Cable Lifter Windlass : Type 2

Single fully powered windlass with one cable lifter (see Fig. 1B).

3.9 Single Cable Lifter Unit : Types 3 and 4

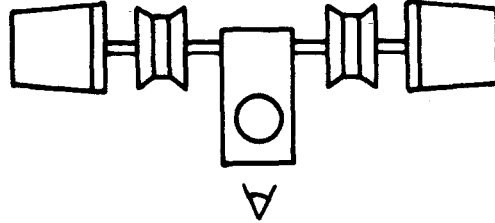
A windlass unit in which one cable lifter is provided

with an external power source (see Fig. 1C and 1D).

3.10 Handling of Windlasses

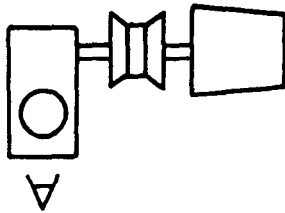
Windlasses of Types 2 and 3 may be designated as right-hand or left-hand models.

3.10.1 A windlass is termed a right-hand windlass in relation to an observer situated on the side of the

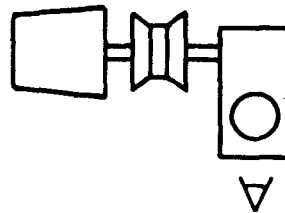


CENTRAL MODEL

1A Type 1 Symmetrical Double Cable Lifter Windlass, Fully Powered



LEFT HAND MODEL



RIGHT HAND MODEL

1B Type 2 Single Cable Lifter Windlass, Fully Powered



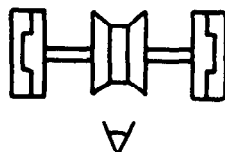
LEFT HAND MODEL



RIGHT HAND MODEL

POWER CLUTCH

1C Type 3 Single Cable Lifter Unit, Externally Powered



CENTRAL MODEL

1D Type 4 Single Cable Lifter Unit, Driven by Two External Prime Mover

FIG. 1 DIFFERENT TYPES OF WINDLASS

motor, power supply or controller when the drive for the cable lifter or cable lifter unit is on the right-hand side of the cable lifter.

3.10.2 A left-hand windlass when similarly observed has the drive for the cable lifter on the left-hand side of the cable lifter.

3.11 Breaking Load of the Chain Cable

Minimum breaking load specified for the diameter and grade of chain cable.

3.12 Anchorage Depth

Depth measured as the water height from the sea level at the point of anchoring.

4 GENERAL REQUIREMENTS

4.1 Anchor Chain

This standard is based upon the use of three grades of anchor chains in accordance with IS 4484.

4.2 Cable Lifter

4.2.1 Cable lifter shall be used in accordance with IS 6675. The cable lifter shall have at least five snugs.

4.2.2 The cable lifter shall be declutchable from the drive. The power operated clutches shall also be declutchable by hand.

4.3 Warping Ends

4.3.1 The windlass may be designed with or without warping ends.

4.3.2 The warping ends may be fitted on the intermediate shaft or on the cable lifter shaft.

4.4 The windlass shall be capable of taking load when the vessel is riding on anchor or due to weighing, that is, for lifting the anchor from ground under all normal conditions.

4.5 The windlass seats shall be of adequate strength. They may be in the form of a seal box, but if of open construction, provision shall be made to prevent accumulation of the water and to give adequate access for cleaning and painting of the structure. The thickness of deck in way of the windlass shall be increased and adequate stiffening shall also be provided. The windlass shall be properly chocked, efficiently bedded and secured to the deck.

4.6 The minimum angle of contact between chain and cable lifter shall be 115° for horizontal windlasses, so as to ensure that the collars of two successive sprockets are active simultaneously when the chain

is subjected to a pulling strain.

4.7 Strength Requirements

The manufacturer of the windlass shall be responsible for determining the strength requirements of the component parts of the windlass so that:

- a) if a cable stopper is fitted, the windlass with brakes engaged and cable-lifter disengaged shall withstand a pull of 45 percent in case of Grade 1 chain, 63 percent in case of Grade 2 chain and 90 percent in case of Grade 3 chain of the breaking load without any permanent deformation of the stressed parts and without brake slip;
- b) if a cable stopper is not fitted, the windlass is to comply with the requirements of the Classification Societies/Statutory Authorities;
- c) the stresses in those parts of the windlass and the windlass frame concerned are below the elastic limit of the material used;
- d) attention is to be paid to:
 - i) stress concentration in keyways and other stress raisers,
 - ii) dynamic effects due to sudden starting or stopping of the prime mover or chain cable,
 - iii) calculation methods and approximations used when deriving the design stresses, and
- e) attention is drawn to the requirements of the classification Societies.

4.8 Braking System

4.8.1 Control Braking System

4.8.1.1 Electric windlasses shall be provided with an automatic control braking system which comes into operation when bringing the operating device to the stop on braking portion and also when there is no power on the windlass.

4.8.1.2 The control brake system shall be capable of holding a load at least 1.5 times the working load.

4.8.2 Cable Lifter Brake

4.8.2.1 Each cable lifter shall be fitted with a hand brake, capable of applying a braking torque sufficient to maintain a load equal to the holding load, when the cable lifter is declutched from the drive. As an additional requirement, the hand brake be remotely controlled.

4.8.2.2 Provision shall be made to minimize the possibility of accidental release of the brake.

4.8.2.3 The brake shall be capable of maintaining the working load when the windlass is unattended.

4.8.2.4 Brakes applied by hand shall require a force not exceeding 160 N in order to exert the braking torque of 25 percent in excess of the driving torque required to maintain the working load. The force supplied to a foot pedal to exert the same braking torque shall not exceed 320 N.

4.9 Emergency Stop

4.9.1 Each windlass shall be fitted with a quick acting, local emergency stop mechanism, which when operated, removes power from the windlass and applies control braking system.

4.9.2 The emergency stop shall be located in a clearly marked and accessible position close to a remotely controlled windlass and adjacent to a manually controlled windlass.

4.10 Speed Control

4.10.1 The speed of the windlass shall be adjustable between 'no load' speed and stop. In the case of electric windlasses, the number of steps and period of operation thereof shall be specified. It shall be possible to make the adjustment while the windlass is working.

4.10.2 The control system shall be such that it is possible to move the controls from full veer position to the full haul position, or *vice versa*, in less than 2 s. The speed with which the controls are manipulated shall not have an adverse effect either on the windlass or the safety of the operator. Windlass response times shall be supplied by the manufacturer to the purchaser on request.

4.11 Protection

4.11.1 Prime movers and gearing shall be protected against excessive torque and shock.

4.11.2 Cable lifter and gearing shall be protected against excessive torque developed by the prime-mover.

4.12 Control Methods and Movements

4.12.1 The control methods and movements shall be in accordance with 4.4 of IS 12719.

4.12.2 Whatever the form of the motive power, the operating device shall, when under manual control, be arranged to return to the braking or stop position

automatically unless otherwise agreed upon between the manufacturer and the purchaser.

4.13 Construction

The construction of the windlass shall be in accordance with 4.5 of IS 12719.

4.14 The information to be provided by the purchaser at the time of enquiry is given in Annex A.

5 PERFORMANCE

5.1 The windlasses shall be capable of continuous operation for a period of 30 min while exerting the working load at the minimum design speed and also be capable of exerting, for a period of at least 2 min at reduced speed, the overload pull determined in accordance with 5.4.

5.2 The chain cable nominal speed shall be not less than 0.15 m/s. A standard anchor/hawse pipe efficiency of 70 percent and a buoyancy factor of 87 percent are assumed.

5.3 The design speed at the warping end shall not be less than 0.2 m/s. The maximum recommended speed at the warping end shall not be less than 0.4 m/s.

5.4 Windlass performance calculations are given in Annex B.

6 TESTING OF WINDLASSES

6.1 Type tests or individual tests shall be carried out at the manufacturer's works, but where it is not possible, the tests may be carried out at a place to be agreed to between the purchaser and the manufacturer.

6.1.1 *Rules Concerning the Test at Manufacturer's Works for the Acceptance of the Windlass by the Purchaser*

The windlass or windlass unit shall be tested as a complete unit (that is, prime mover or slave prime mover, cablelifters, gearing and controls) for the factory running tests and for inspection and test on board ship.

6.1.2 The result of the tests carried out in accordance with 6.2 shall be stated in the test certificate.

6.1.3 When a batch of 5 or more similar windlasses is supplied to one order, type tests on one of these windlasses may be carried out in the manufacturer's premises or at a place agreed to between the manufacturer and the purchaser, if so required.

6.1.4 The type test may be replaced by a type test certificate, if agreed to by the purchaser.

6.1.5 Where tests are required in excess of the type test, these shall be agreed to between the manufacturer and the purchaser at the time of the contract.

6.2 Type Tests

The tests shall be carried out as follows.

6.2.1 Type Test Without Load

The windlass shall be run at a speed not less than nominal speed without load for 30 min continuously, 15 min in each direction. When the windlass is provided with a gear change mechanism, it shall be run for an additional 5 min in each gear position in each direction. While testing, the following shall be checked or measured:

- a) Oil tightness of joints,
- b) Temperature rise of the bearings,
- c) Presence of abnormal noise,
- d) Power consumption,
- e) The speed of rotation of the cable lifter shaft in each direction,
- f) Speed control times for each reversal,
- g) Correct operation of the control brake, and
- h) Correct operation of the cable lifter brake.

Where tests are required in excess of the factory running test, they shall be as agreed to between the purchaser and the manufacturer at the time of the contract.

6.2.2 The windlass shall be checked to verify that the working load, nominal speed and overload pull are attainable as specified in 5.1. While testing, the following shall be checked or measured:

- a) tightness against any leakage,
- b) temperature rise of the bearings, and
- c) presence of abnormal noise.

For windlasses beyond working load of 7.5 t shop test shall be carried out as agreed to between the manufacturer and the purchaser.

6.2.3 Brake Test

The working and satisfactory operation of the control brake and the cable lifter brake shall be tested to ensure compliance with the requirements of this standard (see 4.8.1.2).

The holding load of the cable lifter brake may be

verified by test or calculation as agreed to between the manufacturer and the purchaser. The cable lifter brake shall also be tested with the anchor dropping, controlled and stopped by the brake.

Alternatively, this test may be carried out on board ship.

6.2.4 Open Inspection Test

At the end of type test, the windlass shall be opened and inspected for any defects in the following parts:

- a) Worm shaft and bearings,
- b) Gear wheel shafts and bearings,
- c) Winding drum and bearings,
- d) Thrust bearing,
- e) Brake lining,
- f) Worm and worm gear, and
- g) Gear wheel and pinion.

In the case of gear wheels, the tooth faces shall be checked for proper meshing. For machine cut gears (commercial quality) a minimum of 40 percent of width contact shall be achieved.

6.2.5 Tilt Test

This test is performed to ascertain the proper functioning of the oil seals of the gear case and alignment of the gear train ensuring proper working of the windlass and the motor even when the ship has a list up to 5° and a trim up to 2°. Tilt test may be carried out for small windlasses in the shop. Larger windlasses could be tested on board the ship, during sea trial, if agreed to between the manufacturer and the purchaser.

6.2.6 Where remote controls or other special features are fitted, their satisfactory operation shall be verified.

6.3 Individual Tests

These tests shall be carried out in accordance with 6.2.1.

6.4 On Board Tests and Inspections

6.4.1 The shipbuilder together with the manufacturer of windlass shall arrange for the following inspections and tests to be carried out on board the ship in the presence of the shipowners, prior to handing over the ship, to ensure that the windlass is fully operable.

6.4.2 Primary Inspection

6.4.2.1 Inspection ports to be opened and interior or casing checked for cleanliness, surface deterioration

and foreign matter

6.4.2.2 If fitted, filters in hydraulic lines to be checked for cleanliness.

6.4.2.3 Power connection to be checked for tightness.

6.4.2.4 Deck and casing connections to be checked for tightness.

6.4.2.5 Check that the correct grade of lubricant has been supplied in sufficient volume for safe operation. Sumps and oil baths to be checked for correct volume of oil.

6.4.3 Running Tests

6.4.3.1 Test without load

The windlass shall be run under ship power without load in accordance with the requirements of 6.2.1. The results of the test shall be compared with the factory running test certificate.

6.4.3.2 Load test

The windlass shall be run under ships' power and shall demonstrate the capability of each cable lifter to:

- a) recover the anchor and cable at design speed from a depth of 82.5 to a depth of 27.5 m;
- b) exert, for a period of at least 2 min, the overload pull determined in accordance with 5.4.

NOTE — The depth of water may not permit full suspension of the anchor and cable during the tests, in which case agreement must be reached between the parties concerned.

6.4.3.3 The control brake, cable lifter brake and slipping clutch or relief valve, where fitted, shall be seen to operate satisfactorily.

6.4.3.4 The cleanliness of any oil filters shall be noted after the test.

6.4.4 Bearings

Bearing temperature rise to be measured for the test without load and checked against the factory test certificate. Abnormal temperature rise should be investigated.

6.4.5 Additional Tests

Other tests may be requested by the purchaser at his

expense and convenience

7 DESIGNATION

The windlass shall be designated by:

- a) Type (*see* 3.7 to 3.10);
- b) Type of drive;
E = electric, h = hydraulic;
S = steam, EP = externally powered;
- c) Nominal size (*see* 3.2);
- d) Grade and diameter of anchor cable;
- e) Maximum anchorage depth in metres; and
- f) Number of this standard.

Example:

A type 2 electrically driven windlass of nominal size 12 using 58 mm Grade 2 chain at 82.5 m anchorage depth shall be designated as:

Windlass — IS 7937-2E-12/58/2-82.5

8 MARKING

8.1 All windlasses shall be permanently marked with the following information on a rating plate, prominently displayed:

- a) Manufacturer's name or trade-mark and serial number,
- b) Number of this Indian Standard,
- c) Nominal size, and
- d) Maximum anchorage depth in metres.

8.1.1 The windlasses may also be marked with the Standard Mark.

8.1.2 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

ANNEX A*(Clause 4.14)***INFORMATION TO BE SUPPLIED BY THE PURCHASER**

A-1 The purchaser shall provide the manufacturer of the windlass with the following basic information at the time of enquiry:

- a) Windlass to IS 7937;
- b) Type of drive required (electric, hydraulic, steam or external drive), also power supply, voltage, No. of steps, pressure, etc, as applicable;
- c) Nominal size;
- d) Whether left or right-handed or symmetrical;
- e) Whether warping ends are required and where located;
- f) Anchor chain diameter;
- g) Grade of anchor chain if other than specified in the standard;
- h) A plan of the ship showing the disposition of the windlass;
- j) If additional tests are to be performed;
- k) If variations are required from standard speeds;
- m) Additional paint finish specification required;
- n) Maximum attitude of windlass if required to be in excess of 15° in any direction from the horizontal;
- p) The amount of deck sheer in way of the windlass shall be stated; and
- q) Any other special requirement of the purchaser;

ANNEX B

(Clause 5.4)

WINDLASS PERFORMANCE CALCULATIONS

B-1 The following performance criteria shall be used in determining performance data for windlasses:

- a) Working load F_{w1} Newtons, for anchorage depth down to 82.5 m:
- Grade 1 Cable : $37.5 d_n^2$
 - Grade 2 Cable : $42.5 d_n^2$
 - Grade 3 Cable : $47.5 d_n^2$

where

$$d_n = \text{chain cable diameter, mm.}$$

The windlass shall have sufficient power to exert over a period of 2 min, a pull equal to 1.5 F_{w1} .

- b) Working load F_{w2} Newtons, for anchorage depth deeper than 82.5 m

$$F_{w2} = F_{w1} + (D - 82.5) 0.27 d_n^2$$

where

$$D = \text{anchorage depth, m.}$$

The windlass shall have sufficient power to exert a pull at least equal to 1.5 F_{w2} .

- c) **Holding Load** — The windlass with its braking system in action and conditions simulating those likely to occur in service, shall withstand a load without permanent deformation or brake slip as follows:
- i) With cable stopper :
- : $0.45 \times$ the breaking load of Grade 1 chain;
 - : $0.63 \times$ the breaking load of Grade 2 chain; and
 - : $0.90 \times$ the breaking load of Grade 3 chain.
- ii) Without cable stopper : in accordance with the requirements of the Classification Societies.

B-2 For the information of shipbuilders, owners, and equipment manufacturers the following performance

criteria shall normally be used to determine whether a windlass has sufficient power and is suitable for its purpose.

B-2.1 The windlass shall be capable of exerting, for a period of 30 min a continuous duty pull in accordance with 5.4.

B-2.2 The windlass shall be capable of exerting a short period pull of $61.8 d_n^2$ N or, if it be greater, a pull sufficient to raise a standard stockless anchor associated with anchor cable from a depth equal to 25 percent of the total length of anchor cable required to be carried on board, that is, approximately 50 percent of the length of cable carried on one side of the ship.

B-2.3 The windlass shall be capable, on trial on board ship, of raising an anchor from a depth of 82.5 to a depth of 27.5 m at a mean speed of not less than 0.15 m/s.

B-2.4 The windlass shall be able to withstand, with the brakes fully applied, a proof load of $4.4 d_n^2 (40 - 0.8 d_n^2)$ N, for Grade 1, $6.2 d_n^2 (40 - 0.8 d_n^2)$ N for Grade 2 and $8.8 d_n^2 (40 - 0.8 d_n^2)$ N for Grade 3 applied to the cable.

B-2.5 The windlass shall be so designed that release of the cable does not occur if a load equal to the breaking load of the special steel cable is applied to the cable.

B-3 Attention shall be paid to stress concentrations keyways and other stress raisers and also the effect of snatch loading or sudden stopping of the prime mover or anchor cable.

B-4 It should be noted that the above criteria do not require both anchors to be raised or lowered simultaneously on windlass fitted with two cable lifters, but consideration shall be given to minimizing the probability of declutching a cable lifter from the motor with the cable lifter brake in the off position.

B-5 When consideration of the above criteria reference shall be made to the Classification Society requirements for the following items:

- a) Cable weights,
- b) Hawse pipe efficiency, and
- c) Anchor weights.

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Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Handbook' and 'Standards : Monthly Additions'.

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